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Red Is Good
Transformational Changes for US Air Force Aircraft Maintenance

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Colonel, USAF

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Foreword

Over the last two decades, the Air Force's fleet of aircraft has shrunk 40 percent, while the average inventory age has increased from eight years in 1973 to a projected 26.5 years by 2012. Concurrently, this smaller, older fleet has been tasked with 2.3 million flight hours per year since the end of Operation Desert Storm. In an environment of flat budgets, limited manpower, and an aging, shrinking fleet, the Air Force seeks cultural transformations to remain the world's premier air, space, and cyberspace force. The transformation initiative Air Force Smart Operations for the 21st Century (AFSO21) was designed to increase productivity, responsiveness, and efficiency, thus improving equipment readiness, reliability, and availability.

Given the mixed results of past transformation efforts, has AFSO21 achieved the desired effects? Col Paul "P. J." McAneny offers an analysis focused on aircraft maintenance but applicable to the entire force and recommends cultural changes to support lasting transformation. He examines the impact of metrics on transformation and evaluates the USAF aircraft maintenance culture. He asks several questions: Can focused metrics precede cultural change? Does the aircraft maintenance community support a Red Is Good culture, in which metrics are used to illuminate problems rather than measure success or failure? If so, is the community a true learning organization that can maximize its impact through continuous process-improvement initiatives? The answers lead Colonel McAneny to recommend several Air Force–level changes to meet long-term aircraft readiness and reliability targets.

As with all Maxwell Papers, the Air War College publishes this study in the spirit of academic freedom and open debate. We encourage your engagement on the issues the paper raises and solicit your responses.

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Colonel McAneny received his commission from the Reserve Officer Training Corps in 1987. He is a 2009 graduate of the Air War College. Prior to his assignment at Maxwell AFB, Colonel McAneny was the deputy commander of the 437th Maintenance Group, 437th Airlift Wing, Charleston AFB, South Carolina.

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I would also like to thank all the individuals I interviewed personally or corresponded with. While the views were quite diverse, the end goal remained the same: to serve the Total Force more effectively in an era of declining resources. Those individuals who deserve special mention include Col Robert Hamm, Headquarters Air Education and Training Command (HQ AETC/A4/A7D); and Dr. Ronald Ritter, Secretary of the Air Force's Smart Operations Office (SAF/SO).

Finally, I would like to thank my wife, Rebecca, and my three daughters, Campbell, Madeleine, and Erin, whose unconditional love and patience for their oft-absent husband and father were instrumental in seeing this endeavor through to completion.

Red Is Good

Transformational Changes for
US Air Force Aircraft Maintenance

If it ain't broke, don't fix it. True but . . . if you don't know it's broke, it don't get fixed.

—Gen Bill Creech
The Five Pillars of TQM

Introduction

Over the last 20 years, the US Air Force has seen a 40 percent reduction in the size of its air fleet, while the average age of that inventory has gone from eight years in 1973 to 24 years in 2008. The negative trend is expected to continue to a projected average age of 26.5 years by 2012.[1] On any given day, 14 percent of the remaining fleet (about 800 aircraft) is either grounded or operating with age-related flight restrictions.[2] Since the end of Operation Desert Storm, the Air Force has maintained an average rate of 2.3 million flight hours per year with a fleet that is much smaller and older than the one fielded during the first Gulf War.[3] Operations Iraqi Freedom (OIF) and Enduring Freedom (OEF) have put further stress on the fleet; thus, aircraft will reach their projected service life much sooner than planned or budgeted for.

Within this challenging environment of flat or decreasing budgets, limited manpower, and a rapidly aging air fleet, the Air Force sought a way to transform its culture not only to survive but to remain the world's premier force in the domains of air, space, and cyberspace. The Air Force transformation initiative, called Air Force Smart Operations for the 21st Century (AFSO21), was begun after considering only the effects desired, not the organizational-level changes required to successfully implement the transformation. The desired effects of AFSO21 are

1. increasing Airman productivity,

2. improving readiness and availability of critical equipment,

3. increasing responsiveness and agility,

4. sustaining and improving operational safety and reliability, and

5. increasing energy efficiency.[4]

This paper focuses on the cultural changes required to achieve the desired effects of AFSO21, based on the relentless pursuit of continuous process improvement. However, successful, valid, reliable, and continuous process improvement is only possible in an environment that tolerates, encourages, and promotes the public airing of dirty laundry. Others have labeled this a Red Is Good mentality, from the well-known construct of PowerPoint metrics briefings using red, yellow, and green stoplight charts to depict established target status.[5] In a Red Is Good culture, problems are viewed as great opportunities to improve rather than failures or threats. Toyota Corporation is recognized globally as a benchmark for fostering a Red Is Good culture, demonstrated by Toyota president Katsuaki Watanabe's visit to one of his US manufacturing plants. When shown that the plant met the metric targets (all green) for its most recent reporting period, Watanabe observed, to the dismay of his US managers, "Ah, no problems, must need no managers."[6] Watanabe curtly and elegantly conveyed that metrics and goals were useless if leaders weren't using them as tools to find process problems and waste that could be eliminated. Unfortunately, many current USAF leaders look at metrics from the exact opposite point of view—as an opportunity to show others that they are on top of their game and meeting or exceeding all expectations.[7] In other words, they have a Green Is Good mentality.

This investigation will be framed by three research questions (RQ):

RQ1: Can focused metrics precede cultural change?

RQ2: Does the Air Force, specifically the aircraft maintenance community, currently support a Red Is Good culture?

RQ3: If so, is the aircraft maintenance community a bona fide learning organization that can achieve the greatest impact possible from continuous process-improvement initiatives?

This analysis will examine metrics and their impact on transformational culture change and evaluate USAF aircraft maintenance community initiatives. Answers to these questions will generate several recommended changes at the Air Force enterprise level if the service hopes to achieve simultaneous efficiency and effectiveness targets for aircraft readiness and reliability—the desired effects of AFSO21.

Culture Change and Transformation

Most transformation programs start on the wrong foot. And because they often follow in the wake of failed restructuring efforts that have left indelible scars on the workforce, they are seen as just another attempt at cost reduction.

—Tony Hope and Jeremy Hope
Transforming the Bottom Line

What is organizational culture? How should the Air Force be categorized as an organization? What are the common characteristics of successful cultural change agents in large organizations? Where does the current AFSO21 (Lean) transformation fit into this discussion? Edgar Schein defines culture as "a pattern of shared basic assumptions learned by a group as it solved its problems . . . [and] taught to new members as the correct way to think and feel in relation to those problems."[8] By Schein's characterizations, today's Air Force is a mature organization where culture defines leadership rather than leadership defining culture. Mature organizations can function successfully for many years, so long as their cultural assumptions remain relevant to the external environment. However, if the environment changes and the organization can't adapt, that inflexibility leads to a period of rapid decline.[9] Furthermore, if mature organizations have a long history of success grounded in certain core assumptions about themselves and the environment, they are unlikely to

challenge or reexamine those assumptions because they remain a significant source of pride and self-esteem. This reluctance can act as a filter (or blinder) and prevent key leaders from recognizing alternative, but necessary, means of survival.[10]

Successful cultural transformation starts with a well-constructed vision instilling a forward-looking mind-set that positions the organization to move confidently and aggressively toward bold objectives.[11] Further, the vision of transformational leaders must consistently and clearly communicate organization priorities, goals, and assumptions throughout the workforce. This is known as organizational alignment. If ignored, workers become preoccupied with their individual task stovepipes and procedural details.[12] But when a company has synergistic and mutually supportive metrics, goals, and objectives at all organizational levels, a complete organizational alignment—true change and transformation—is possible. Aligned organizations have clear objectives, a common language, and a trust-based, open information system.[13] Once these conditions for success have been set, a culture of excellence where great ideas flourish from the bottom up is truly possible. The trick, and the problem, is successfully converting these ideas from concepts to actions. Transformational leaders can break through corporate cultural inertia by seeking, promoting, and celebrating progressive thinking.[14] Jim Collins, author of *Good to Great*, says, on the other hand, that it is just as important to avoid demotivating people by failing to deliver results on their progressive thinking. Instead, change agent champions "point to tangible accomplishments—however incremental at first—and show how these steps fit into an overall concept that will work. When leaders do this in such a way that people see and feel the buildup of momentum, they will line up with enthusiasm."[15]

Organizational culture analysis demonstrates that it takes anywhere from three to 10 years to successfully change the fundamental culture of a large organization.[16] Unfortunately, the AFSO21 Lean transformation efforts were flawed from the start, following the very pattern criticized by Hope and Hope in *Transforming the Bottom Line*. The service programmed major budget cuts (primarily personnel accounts) between 2007 and 2011 to save 21 billion dollars *while*

assuming risk until transformational capabilities were identified.[17] Instead, successfully transforming organizations must first reduce the workload, not the work force.[18] The Air Force did the exact opposite. It cut manpower budgets while assuming that workload reductions and speed and quality improvements would follow. Air Force leaders must reevaluate their basic assumptions about service transformation to attain the effects desired with AFSO21. Only then will the Air Force be capable of the bold policy and organizational changes necessary to facilitate transformation.

Metrics, Goal Setting, and Cultural Connections

> *Goals without metrics are more of a hallucination than a vision.*
>
> —Alex Miller, Chuck Parke, and Harry Gregory
>   Leading for Results course
>   University of Tennessee

> *What gets planned, gets measured. What gets measured, gets done.*
>
> —Wayne Turk
>   "Is Your Project on Track?"

Metrics can and do influence corporate culture, whether by intention or not. To be effective, metrics must flow from a clearly defined strategy. An organization that fails to measure itself correctly will not know how or where it falls short.[19] Metrics, when properly developed and utilized, provide leaders with valuable tools to measure progress and lead change across all organizational levels. The most effective metrics are customer focused and capture the entire value stream. However, a misapplied focus on metrics can be a powerfully counterproductive force in corporate culture and actually hinder organizational progress.

First and foremost, metrics should always reflect the value of the organization's product to the customer, ensuring delivery at the right place, time, quantity, quality, and price.[20] In developing metrics, the core questions should be, "Where are we going?" and "How do we get there?"[21] Value-stream visible metrics have the following attributes:

- accurate (reliably expresses the phenomenon being measured),

- objective (not subject to dispute),

- comprehensible,

- timely, and

- robust (resistant to being gamed and hard to manipulate).[22]

Another important point for leaders to consider in metrics development is unity of focus for the best return on investment. Leaders should personally champion no more than five of the highest-level critical end-product metrics and cascade responsibility for supporting metrics downward through the organization. Goal setting is also a critically important leadership task and is linked directly to encouraging team members to achieve higher levels of performance than they might have thought possible. Incremental and realistic increases in goal difficulty raise the level of effort required to achieve goals while simultaneously expanding the performance envelope of the entire enterprise stream.[23] Metrics are worthless unless the results are critically reviewed on a regular basis, with the target being complete process improvement. Good metrics should allow target setting, identify issues and problems, and provide feedback on process efficiency and effectiveness.[24] Metrics displayed in simple and visible scoreboards let all personnel know how they are doing—as the simple stoplight chart does, using red (significant problems that could impact success), yellow (correctable problems), and green (everything is on time, on budget, etc.) indicators.[25]

Good customer-focused metrics encompass the entire value stream. Rather than using traditional metrics just because they are "what's always been tracked," an organization should consider eliminating metrics that don't create value as perceived by the customer. Once set and focused on key high-return processes, value-stream ownership should be assigned to a specific individual or small group. That person or persons are empowered with total responsibility

and authority to improve performance within the value stream.[26] This is much more effective than isolated attempts to maximize "stovepipe" performance, because ultimately final output is constrained by the lowest level of support, or bottleneck, in any component of the value stream.[27] To summarize, there are four guiding principles of metrics for value-stream teams:

1. Targets should be aligned with strategy.

2. Teams play a role in choosing targets.

3. Focus on the customer including possible development of new metrics.

4. Measures should influence behavior.[28]

Assigning team empowerment to value streams is the most powerful tool at any leader's disposal. While leaders are solely responsible for setting strategy—owning the process—teams should be the primary unit of execution and do all the real value-creating work.[29] Teams at Toyota Corporation take ownership of the entire value stream and use the plan-do-check-analyze (PDCA) cycle to achieve process improvement where it can be most effective.[30] The PDCA cycle is a systematic method that codifies the "continuous" in continuous process improvement. Planning involves analyzing the value stream, finding the areas with the most waste, and deciding what adjustments to make in order to remove that waste from the process. The *do* step involves carrying out the corresponding plans of action. Checking means judging results of actions (feedback) taken against predetermined targets in the *do* step—in other words, comparing what should have happened with what actually happened in order to make further refinements. Good checking requires an atmosphere friendly to peer- and self-criticism. Otherwise, if personnel sense that failed attempts at process improvement are perceived negatively by leadership, honest feedback will be lost. Progress is impossible without an atmosphere where mistakes can be freely reported. Finally, the *analyze* step is as simple as it sounds: reflect on the results of the *check* step. If the

results from the *check* step meet the target, then standard-
ize. If not, find the root cause and restart the PDCA cycle.[31]
Two critical questions are:

1. Does the organization have a culture that supports
    and encourages systematic problem solving?

2. What really happens when people report problems?[32]

Creating a culture where the bearer of bad news is lionized
rather than ostracized is one of the most difficult things for
any leader to achieve. The 2008 resignations of the secretary
of the Air Force and the chief of staff are illustrative. While
the secretary of defense's official statement said that these
resignations were specifically related to recent Air Force
missteps involving custody of nuclear weapons and compo-
nents, many in and outside the Air Force believe otherwise.
Michael Dunn, Air Force Association president, recently
summed it up by stating, "Secretary Wynne and General
Moseley have been outspoken in pointing out the Air Force
needs to recapitalize and modernize the fleet. . . . It is apparent
to us that the Department of Defense did not appreciate the
military advice nor the warnings they were getting."[33] This
effectively signaled to the entire Air Force that our organiza-
tion maintains a Red Is Bad culture. In a Red Is Good cul-
ture, problems are viewed as opportunities for systematic
problem solving.
   A Red Is Bad culture is not unique to the Air Force. There
are numerous instances of many working in service and
maintenance type industries where the only experience
with metrics and data is negative. In some production
environments, metrics are used to punish low performers,
justify cutbacks, and support dubious arguments that foster
an environment of distrust and wariness.[34] This leads to
inaccurate or inflated job completion estimates to create a
buffer in order to minimize reprimands for not meeting the
schedule. On the other hand, reporting realistic estimates
and system problems would allow leaders to have full and
accurate process visibility to better manage uncertainty
and risk in the daily schedule.[35]
   Rather than being a pass/fail indicator, metrics should
instead be used to judge process efficiency and effectiveness

as well as identify trends.[36] Furthermore, metrics should be constantly refined to ensure that leaders and process owners can get to, and remain focused on, the heart of the issue.[37] No leader wants to be in a situation where process owners are reluctant to provide data that reflects negatively on the process. This human tendency must be overcome, or else it creates a false reading of current project status.[38] It is important to remember what should be the true purpose of all good metric rating systems: to help tell a story and gain a shared understanding of what's important. Effective rating systems should lead to problem discovery and result in solutions.[39]

This discussion of metrics leads to the cultural connection question, Can metrics influence culture? W. Bruce Chew, a Harvard expert on factory productivity in America, believes metrics do influence behavior if they are properly created. Chew states, "When the primary goal is to influence behavior, the simpler the better must be the rule. If the people who use an index can't understand it at a gut-level, it probably will not affect their decisions and priorities."[40]

In fact, measurement systems drive behavior at all levels, and the choice of measures is critical to the behavior to be influenced.[41] Therefore, it is critical that managers consider who and what will be influenced by the metrics they choose to track.[42] Enterprise metrics, those specifically designed with the intention of aligning incentives and behavior across the entire organizational value stream, ensure that both individual and corporate goals are synchronized.[43] Truly transformational metrics discourage personnel from focusing only on their individual production stovepipes and instead encourage them to think about the value, quality, quantity, and timeliness of the final output product.[44] Simultaneously, keeping internal process metrics in perspective is important to prevent an overemphasis from suboptimizing real customer value.[45] Ultimately, behavior guided by consistent application of metrics and goals over time leads to a real and permanent culture change that successfully considers the entire value-stream process. When a leader has accomplished that, the corporate culture has taken a major step towards successful, long-term, continuous process improvement.

Current Air Force Aircraft Maintenance Metrics

Choosing metrics for metrics' sake is a bad thing and really proves nothing. A good maintenance manager will not strive to improve a metric but will use it to improve the performance of the organization.

—Brig Gen Terry L. Gabreski, USAF
Foreword to *Air Force Maintenance Metrics*

The US Air Force flies 430 sorties per day in support of OIF and OEF. In fact, the Air Force airlift fleet averages a takeoff every 90 seconds, every day, 365 days a year.[46] Reams of data on operational tempo, flight hours, and so forth are collected by Air Force maintenance data analysts. These measurements enable predictive estimates of structural fatigue, system performance, and airframe service life. Research shows cost per flying hour increases significantly during the first 12 years of aircraft service life, so it is important to collect and track these metrics for predictive analysis.[47] The most recent version of the *Air Force Maintenance Metrics* handbook lists 34 primary maintenance metrics to track.[48] These are used not only for predictive analysis, but also for trend analysis and progress checks. Recent independent research studies by the Air Force Logistics Management Agency (AFLMA) and the Office of Aerospace Studies (OAS) highlighted problems with aircraft maintenance data validity as well as the absence of a systematic method for goal setting at higher headquarters. Likewise, other studies have shown how nonaligned metrics suboptimize, or undermine, the desired enterprise-level performance for some weapon systems. Finally, a Green Is Good/Red Is Bad culture still permeates the aircraft maintenance community.

The metrics used to reflect fleet health at both wing and enterprise level for the aircraft maintenance community are mission capable (MC) rate, aircraft (sometimes called fleet) availability, home-station logistics departure reliability rate (HSLDR) for mobility air forces, and utilization rate (UTE) for combat air forces. MC rates are simply determined by the number of aircraft that can fly at least one assigned mission divided by the number of aircraft possessed by the entire wing. Aircraft availability is the metric for determining

"health of the inventory" and is dependent on the MC rate as well as the number of aircraft across the entire enterprise (possessed, backup, depot, etc.).[49] This measure is useful for determining if the total logistics enterprise is capable of providing sufficient aircraft to accomplish mission requirements. A certain percentage of the fleet must always be available on any given day in order to execute the Air Force's flying program.[50] HSLDR metrics judge operational effectiveness based on customer needs in the mobility air forces and are determined by comparing on-time takeoffs to deviations from the flying schedule.[51] For the combat air forces, UTEs are the local measure of effectiveness, counting the number of flying hours an aircraft is utilized during a given month, quarter, or year.[52]

Traditionally, MC rates have been a common benchmark. A typical unit would compare its MC rate against established major command (MAJCOM) standards or against the rates of similar units. Units that were lower in comparison to these benchmarks would then try to identify the influencing factor (process, policy, or resource) and seek remedies.[53] More recently, enterprise leaders have preferred to focus on aircraft availability because it best articulates systemic fleet stress levels and overall combat capability. Aircraft availability provides a direct answer to the question, How many aircraft are ready right now?[54] Aircraft availability is impacted by MC, not mission capable for maintenance (NMCM), and not mission capable for supply (NMCS) rates as well as factors such as aircraft in depot or undergoing modifications.

The Air Force has been collecting maintenance data for decades but suffers from three data-collection problems common to service environments:

1. There is so much data that it is difficult to separate the wheat from the chaff.

2. For various reasons, some collected data is no longer available.

3. The data often does not measure what it purports to measure.[55]

These problems violate the guiding principles for metrics of value-stream teams. Recently, the AFLMA and OAS

collaborated on a study of C-5 maintenance data. They discovered that much of the data on past C-5 modifications was lost when C-5 depot responsibilities transferred from Kelly AFB, Texas, to Warner Robins AFB, Georgia.[56] The AFLMA also found that aircraft maintenance metrics were inaccurate and vulnerable to both intentional and unintentional manipulation. Researchers uncovered delays in recording aircraft status changes to "not mission capable," after aircraft status had already changed.[57] AFLMA also discovered systemic problems involving maintenance metrics. Procedural methods for reporting broken aircraft systems obfuscated the actual cause. Ultimately, lack of input control and discipline in following electronic data-reporting procedures injected doubt into the entire maintenance data-collection process.[58] On top of doubts about the actual data, AFLMA also found no formal methodology or analysis involved in determining the metric goals for C-5 MC, NMCM, or NMCS rates.[59] Likewise, a separate Government Accountability Office (GAO) study found that Air Combat Command has no historical record of any process establishing most of the metric goals for its primary aircraft maintenance metrics.[60] GAO investigators suggest "the lack of documentation in setting the goals ultimately obscures basic perceptions of readiness and operational effectiveness" while wasting the time of wing aircraft maintainers who attempt to meet standards having no basis in actual organizational performance.[61]

Air Force maintenance metrics also have alignment issues. Proper organizational alignment is present where, with all other variables held constant, improvement in lower-level metrics leads to improvement in the higher-level metrics.[62] While it is common to see different metrics at different organizational levels, this split focus can be problematic when local goals are not aligned with the overall enterprise strategy.[63] This results in suboptimization or an overemphasis on a particular metric that ignores the actual root cause of the core problem and may in fact exacerbate the problem.[64] An AFLMA study revealed misalignment between the primary wing-level leadership C-5 metric, HSLDR, and the Air Mobility Command's primary metric of aircraft availability. The study demonstrated that these metrics were not aligned, with the result that wing-level maintainers were focused on maximizing local operational effectiveness while the MAJCOM

was concentrating on improvements in overall strategic readiness.[65]

Furthermore, the Air Force still lacks the ability for constructive self-criticism, an essential ingredient of continuous process improvement. Metrics must be looked at as tools for fixing problems affecting the process; otherwise their value is questionable. In fact, metrics that "show the pain" best have the greatest value.[66] The Air Force has an Only Green Is Good mentality whereby leadership, often due to a strong self-preservation instinct, has no tolerance for items marked red for noncompliance.[67] An environment where constant deficiency identification is the norm must be the goal. While the Air Force aircraft maintenance community has the obsessive desire to measure just about everything, the wrong things are often measured, and a negative stigma exists against taking the time to study a process closely enough to actually improve it.[68] Only when this paradigm is changed can the Air Force expect sustained operational improvements.[69]

When Air Force maintenance organizations combine effective metrics with a Red Is Good mentality, true long-term improvements will be realized. A dynamic relationship between analysts and maintenance leaders must exist in which the analysts are fully integrated partners with the leader's agenda of long-term process improvement.[70] Good analysis remedies the tendency to focus on final results rather than the critical factors that drive those results. Lean organizations find ways to measure the independent variables, such as resources, funding, manpower, or programming data, that have the greatest effect on fleet readiness.[71] Many units are discovering there are better measures than MC rates to assess how a wing meets sortie production and long-term fleet health requirements. A more effective approach may be increased emphasis on the scheduling process to maintain a balance between daily sortie production for the near term and future fleet health for the long term.[72] Significant transformational process improvement will begin only when wing-level maintenance organizations focus on using metrics for true root-cause analysis to achieve enterprise-level aligned, requirement-driven goals.

The Toyota Production System and Air Force Aircraft Maintenance

You can't tell the winners without a scorecard, or tell the losers either. And without a scorecard, neither winners nor losers will know which they are. No one will know how to get better, either.

—Gen Bill Creech
The Five Pillars of TQM

The success of the Toyota production system and its foundational culture is well known. Facing restricted budgets, limited personnel, and dwindling financial resources, the aircraft maintenance community needs to fundamentally change its culture to improve mission effectiveness. Real cultural change can only be achieved if the Air Force learns and applies the right lessons from observing the Toyota production system and other successful Lean organizations in implementing transformational continuous process improvement.

The Toyota cultural model of a learning organization is the construct many organizations strive to emulate. The core of the Toyota production system is an attitude of self-reflection and self-criticism together with a burning desire to improve. Toyota leaders at all levels are encouraged to openly address things that don't go right and then take responsibility and propose countermeasures to prevent these things from recurring.[73] The difference between Toyota and many other companies is Toyota's fanatical process orientation. Less successful companies have results-oriented leaders or a Green Is Good mentality. Process-oriented leaders are more patient, believing that investments in the people and the process lead to the desired results, while Green Is Good managers want to immediately measure the bottom-line performance of any attempted continuous improvement programs.[74] Many companies and leaders are unable to accept the paradox that by continually surfacing problems and stopping to fix them as they occur, waste is eliminated and productivity soars. Instead, assembly lines are run continuously and problems accumulate, eventually

causing lower quality and increased delays.[75] Toyota also ensures that all leaders clearly understand the company's core value stream. Likewise, all internal service operations view their role as supporting the core value stream. The leaner the core value stream, the leaner the supporting operations can be.[76] Toyota leaders are commonly described as focused on the long term, dedicated to the company's core values, and possessed with detailed hands-on value-stream knowledge. At Toyota, problems are seen as opportunities to train and coach other employees.[77] Unfortunately, for many organizations the essence of building in quality has been lost in bureaucratic and technical details. This is why Toyota incorporates their PDCA cycle into four easy-to-understand steps:

1. Go and see.

2. Analyze the situation.

3. Use one-piece flow and visual signals to surface problems.

4. Ask Why? five times.[78]

The most important metrics to Toyota leaders are those driving problem solving and supporting process orientation. These value-stream measures test everything from lead time to first-pass quality to cost. Aggressive goals begin at the executive level, and each lower level develops measurable annual objectives designed to support those leadership goals. These metrics are updated daily and become more specific lower down in the process hierarchy.[79] Of note, metrics having no influence on improving core value-stream operational excellence or those enabling suboptimization are eliminated.[80]

How can the Air Force maintenance community emulate Toyota's effective continuous process-improvement culture? Achieving the Toyota level of transformation requires both patience and perseverance—organizational culture is both the creation and product of a learning organization. It has taken Toyota well over a decade to build a North American organization that resembles the learning enterprise it built over the course of several decades in Japan.[81] The challenge is in creating an aligned organization of employees who

share the organization's core beliefs and continually learn together.[82] To learn means to have the capacity to build on the past and incrementally move forward, rather than starting over and reinventing the wheel with each new leadership change. This is the fulcrum point of the Air Force's challenge. To build a learning organization, it is necessary to have stability of personnel, slow promotion, and carefully planned succession systems to protect organizational knowledge bases.[83] Successfully transforming culture takes years of applying consistent approaches and principles. To its credit, the Air Force has made attempts to become a learning organization but has fallen far short of the Toyota model. As commander, Tactical Air Command, General Creech instituted senior-officer immersion programs. General Creech rightly believed that "it's when leaders do not understand the challenges—and the real problems and issues—that they give direction that adds to the problem rather than to the solution."[84] In General Creech's program, wing senior officers (normally colonels and above) were required to spend two weeks working side by side with Airmen as they went about their daily routine. The purpose was for wing senior leaders to gain a deeper understanding of the environment, challenges, and demands faced by Airmen on a daily basis. At the end of the two weeks, these leaders were required to provide a written report to General Creech with insights and recommendations. Since General Creech's retirement over 20 years ago, less ambitious incarnations of this program continued sporadically. While the benefits of the Creech immersion program are intuitively obvious, they pale in comparison to the learning organization model at Toyota, where value-stream managers understand virtually every facet of the process they lead. This problem is particularly acute in aircraft maintenance, where officers and senior noncommissioned officers (NCO) are frequently rotated and often have little or no experience with the weapon system they are charged with supporting.

A transformed learning organization would enable the Air Force to empower a new breed of wing-level leaders: a chief process officer who takes ownership of understanding, tracking, measuring, and optimizing crucial end-to-end aircraft maintenance business practices. These leaders must establish the right maintenance process metrics,

measure performance, devise improvements—or reengineer a process that is clearly broken—and establish a continuous program of process optimization, as Toyota's four keep-it-simple steps force managers to do.[85]

The chief process officer must have a firm grasp on enterprise thinking. This "grasp" is defined as a discipline for seeing the whole, recognizing patterns and interrelationships, and learning how to structure these interrelationships in more effective, efficient ways.[86] Toyota has achieved a culture of stopping or slowing down to fix problems to get quality right the first time. While this may sound simplistic, countless organizations have tried to emulate Toyota and failed. The company philosophy of getting quality right first enhances long-term productivity. Toyota developed visual systems to alert teams or project leaders when a machine or process needs assistance.[87] Metric data are used to learn and monitor process performance, not as a method for punishing or rewarding people. Dr. W. Edwards Deming, the famous American engineer who led the quality movement in Japan and later in America, stated that 96 percent of quality problems were built into the work system while only 4 percent were due to individual employee performance.[88] The great majority of experts agree that process rather than people offers the greatest opportunities for continuous improvement.[89] For a variety of reasons, service processes such as aircraft maintenance are full of waste. Service processes:

1. are by their nature slow processes which drive up expense,

2. tend to have far too much work in progress, often as the result of extreme complexity in the service itself, and

3. are flush with non-value-added (to the customer) work typically comprising 50 percent of the total service cost.[90]

This represents a huge potential for enterprise thinkers to achieve significant improvements in speed, quality, and cost. According to Lou Giuliano, CEO of ITT Industries, in an organization full of leaders who are enterprise thinkers,

"everybody's number one task becomes improving the processes for which they have the responsibility."[91]

The Toyota production system also teaches valuable lessons about the potential pitfalls from the introduction of new technology. Jim Collins theorized in *Good to Great* that fantastically successful companies use technology as an accelerator of momentum, not a creator of it. Great companies become pioneers in the application of technology in their business model.[92] The Toyota philosophy towards technology introduction is to not readily compromise its principles and goals for something that is merely faster and cheaper. For instance, using information technology as a cost-cutting measure may have many unintended consequences radically damaging to corporate culture.[93] Instead, Toyota only incorporates thoroughly reliable and tested technology that serves its people and processes. It is not uncommon for mature organizations like the Air Force to attempt to change cultural assumptions by incorporating new technology. New technology causes employees to reexamine their present assumptions and possibly adopt new values, beliefs, and assumptions.[94] While this may indeed be beneficial to the organization, technological seduction is often accompanied by unintended, harmful side effects.

For instance, new technology is often introduced to enable better communication throughout an organization, but instead senior leaders may use the information they gather for control purposes and unwittingly expand hierarchical control.[95] The Air Force is about to begin the rollout of its newest technology effort in support of logistics processes. The Expeditionary Combat Support System (ECSS) is designed to enhance war-fighter support by enabling "improved availability of mission critical weapon systems."[96] ECSS has been designed to transition Air Force logistics processes to a planning-based, cross-functional, integrated (full visibility at all levels), high-performance (new metrics) operation.[97] Overall transformation goals for fiscal year 2011 are a 20 percent increase in equipment availability and a reduction in annual operating costs by 10 percent or 2.75 billion dollars.[98] Transformational changes from ECSS are expected through integration of the entire supply-chain business process and associated personnel roles across the entire value stream. One of the tenets of

the system is increased Air Force–wide asset visibility to improve planning and develop new metrics on weapons system availability, on-time delivery of maintenance events, cycle times, and other data.[99] ECSS will be the primary enabling technology for the new Air Force Global Logistics Support Center (AFGLSC). The AFGLSC is empowered to control the entire Air Force supply chain network.[100] As such, it has the authority to "*redirect* the source, direction, or speed of re-supply" as well as "*change the priority* of maintenance actions to meet changing warfighter requirements."[101] The AFGLSC mission brief states that it will provide "tactical, enterprise-level" management of the supply chain.[102] This oxymoron should signal caution among Air Force maintenance leaders. The Air Force must be cognizant of the unintended abuse of what are referred to as ECSS "Make/Repair" activities. These activities are described as enabling centralized oversight of service, maintenance, repair, and overhaul activities for aircraft, components, facilities, and equipment.[103] Unfortunately, the military has well-documented struggles with information technology systems originally designed for reachback and information sharing but ultimately used to facilitate highly centralized operational execution.[104] A move to centrally control base-level repair priorities is in direct contrast with the decentralized concepts that have served the aircraft maintenance community well since they were instituted by General Creech in the 1980s. His positive organizational changes demonstrated how highly centralized systems robbed wing-level maintenance teams of process ownership and empowerment.[105] As ECSS comes online and the AFGLSC becomes fully operational, Air Force aircraft maintenance leadership must consider mitigation strategies to avoid the loss of wing-level process ownership and empowerment inexorably linked to centralized control of maintenance repair.

Today, the Air Force remains stuck in the nascent stages of its cultural transformation. The initial attempt to transform the Air Force in the early 1990s using Total Quality Management (TQM) principles popularized by Deming was generally recognized as unsuccessful and aborted by service leadership within the decade. More recently, the Air Force made a spirited attempt to embrace quality with its AFSO21 program, vowing not to repeat the mistakes of past

programs. While some high-profile successes have been achieved, most notably at the air logistics centers (ALC), the contention that the Air Force has embraced "partial quality" holds true for others. This partial quality is characterized by a lack of mission focus with the emphasis on efficiency overshadowing effectiveness, leaving many Airmen with the impression that customer service–oriented functions like finance and personnel have been degraded. If AFSO21 initiatives don't ultimately lead to improved operational effectiveness, then Airmen have every reason to question their overall utility. Partial quality also drives the impression that AFSO21 is overly focused on management versus leadership, with NCOs viewing it as just another level of micromanagement.[106] Becoming a learning organization and creating empowered chief process officers while eschewing the allure of information technology–enabled, centralized execution are significant steps towards a permanent, long-term cultural transformation.

Transforming the Culture in Aircraft Maintenance at the Enterprise Level

If you don't know what you are doing, you keep making the wrong mistakes.

—Yogi Berra
Quoted in Gen Bill Creech
The Five Pillars of TQM

In the 1990s, the failure of Air Force TQM programs to approach the lofty goals promised by their most vocal advocates resulted in waning support from military leaders and professional educators. Airmen who saw the quality movement as a way to increase our military edge and improve efficiency were eventually outnumbered by those who saw it as just another square to fill.[107] The Air Force is now several years into its second attempt at transformational culture change. While there have been several well-publicized AFSO21 success stories, a true Air Force transformational culture change remains an unsettled issue. The aircraft maintenance community has served as a test bed for many

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successful AFSO21 initiatives. To lock in these initial successes and support continued growth, changes in leadership methodology, management, and service policies are required—not just in Air Force aircraft maintenance, but at the Air Force enterprise level. These changes include instilling a Red Is Good culture and ensuring that Airmen leading steady process improvement are rewarded and promoted ahead of their peers. At the MAJCOM and Air Force levels, trends toward centralization of base-level maintenance functions must be approached with caution. Finally, the human resource management system for aircraft maintenance leadership should be completely overhauled to grow true learning organizations.

   Changing the culture of any mature organization the size of the Air Force is a daunting challenge. Organizational change management is a disciplined process—guiding an organization and its stakeholders through significant organizational change, addressing the people issues of transformation, and mobilizing individuals and groups at all levels of the organization to support the transformation.[108] In today's Air Force, an appropriate response to ongoing skepticism at all ranks, due to the failures of previous TQM and other transformation initiatives, should be constantly considered. Air Force leaders must understand legitimate skepticism and accept personal responsibility to positively work through it. Successful leaders deeply understand AFSO21 issues and opportunities and forcefully present the case for change.[109] Overcoming cultural norms is a bigger challenge than just mitigating AFSO21 skepticism. The Air Force made rational appeals to Airmen on the importance of a continuous process-improvement culture, declaring that money and manpower pools are drying up. The problem is that Airmen at the local operating level don't perceive they are affected. Therefore, saving programmed Air Force dollars is not an attractive selling point. The question What is in it for me and why should I care? is never really answered.[110] In aircraft maintenance this could be as simple as asking a technician, "When was the last time someone asked you how the job should be done?"[111] In the past, when operational requirements or problems somewhere else in the value stream caused a workload spike, the traditional solution was 12-hour shifts and/or work through the weekend.

Instead, a new Lean Air Force paradigm needs to be mutually beneficial at all levels. Enlightened self-interest is very good as a motivating force. As Col Robert Hamm, the Headquarters Air Education and Training Command deputy director for logistics, states, "Let's use our heads and these new Lean tools to fix our processes because, in my opinion, we won't see the major increases in manpower or money necessary to repair our aging aircraft. . . it's just not realistic. Everybody can get behind 'Let's not work overtime through the weekend to fix this.'"[112]

Ultimately, any successful cultural transformation is going to be leadership driven. Executive-level leaders are the principle source for the generation and reinfusion of an organization's ideology, articulation of core values, and specification of norms.[113] These leaders, or change-agent champions, are the ones whose ideas and initiatives must be rewarded through performance reports, compliments, and formal recognition.[114] In the earliest stages, process-improvement groups will be led from the top down because the pressing need is to change the way employees think by direct demonstration of a better way. By the second stage, however, the process-improvement group will focus more on making leaders into teachers, and Airmen become not just technicians but process engineers. This is *critical mass* for Lean transformation—a point where leaders become coaches rather than dictators and Airmen become proactive learners. This transition is the key to a self-sustaining Lean learning organization.[115] The vast majority of Air Force units have yet to attain this critical transition point.

Air Force maintenance leaders can begin to make the transition by managing for bottom-line results in the organization's value stream. The ultimate goal for any flying wing is increased combat capability. Leaders need to determine the local measurements, goals, and objectives reflected in combat capability and define the end-to-end core value streams impacting those measurements. When value streams or processes that improve combat capability are identified, maintenance leaders must align goals strategically across the entire enterprise and assign specific value-stream managers. The challenge for senior maintenance leadership becomes finding objective metrics to put the true bottom-line output products in clear focus. When performance is measured correctly, it improves. When performance is correctly measured and

compared to goals, historical trends, and like units, it improves more. When significant improvement is recognized and rewarded, productivity soars.[116]

Well-constructed value-stream metrics are used by leaders to manage processes and drive culture change. Leaders must approach metrics as a tool to fix processes rather than a way to assign blame.[117] This is the essence of the Red Is Good culture. In the past the Air Force set out to change culture when instead it should have let culture change come naturally through adherence to metrics and standards. The point is to create a cultural climate where the truth is heard and where red metrics drive questions, dialogue, and debate, not answers. In such a climate, real and intense debate is desired, as opposed to translucent dialogue that lets Airmen "have their say" so we can all get "buy in" to some predetermined decision. Finally, red metrics must create a climate where bad news can't be ignored because it illustrates the very core problems of the value-stream output.[118] There are two possible interpretations of a red metric: a signal of failure to reach targeted value-stream performance or a request for help. In a Red Is Good climate, the focus must be on the requests for help. It is crucial that senior maintenance leaders ensure their entire organization understands that red, yellow, and green stoplights are signals and not grades.[119] A major step the Air Force needs to take to create a Red Is Good culture is a reevaluation of its entire inspection culture. To ensure fidelity and execution following a major inspector general visit, a "fix phase" should be incorporated to allow inspectors and units to interact and correct discrepancies before the inspection team departs the base.[120]

The aircraft maintenance community must remain wary of centralization purported to improve communication, process visibility, and efficiency. General Creech had it right when he stated that a centralized system subordinates ownership and empowerment. He led the original effort to reorganize both flight-line and back-shop maintenance units so they were specifically responsible for their aircraft or end-item spare parts. Team leaders, who had the same skill sets as the Airmen they led, were given responsibility for their entire value stream. These leaders then had total process visibility and a direct impact on flight-line shortages.

Poor performance was easy to track and remedy. Individuals and teams who deserved recognition for stellar process improvement were easy to single out. The Air Force–wide centralized environment that existed prior to General Creech's transformation had no specific output measurements of the various maintenance organizations and, most important, no visible linkage with the larger flying mission of the wing.[121] As the Air Force incorporates the ECSS into the entire logistics enterprise, it must consciously work to avoid unintended consequences by specifically codifying business rules to prevent the natural drift towards centralized repair, which unwittingly removes repair-process ownership from wing-level and lower organizations.

The Air Force Materiel Command (AFMC) ALCs are good models to emulate for wing-level flying organizations. The ALC turn-around over the last decade has been well documented. From fiscal year 1999 to 2002, the AFMC's programmed depot maintenance (PDM) on-time delivery rate, one of the organization's primary value-stream measures, was no better than 81 percent. In other words, the war fighter could count on at least one in five aircraft being returned late from PDM. After AFMC's Lean initiatives, the on-time delivery rate showed dramatic improvement. By fiscal year 2004 it was 92 percent, and in 2005 it reached 99 percent, with one ALC achieving 100 percent. In the A-10 aircraft PDM line, the 120-day total cycle time was reduced 60 percent to just 51 days.[122] So what differentiates ALC maintainers from those in a flying wing maintenance organization? Many note that ALC depot maintenance work does resemble a commercial production process and therefore is more conducive to waste reduction through Lean principle application. While that may be correct, the biggest difference between the ALCs and flying wing maintenance is that ALCs most closely approximate what Toyota labels a learning organization. The ALCs have civil servants in senior production-management positions with many years of experience and genuine hands-on knowledge of all the processes in the value streams they manage and lead. This is not the case in a flying wing, where maintenance leaders at both the officer and senior NCO levels often find themselves managing systems about which they have inadequate hands-on experience. If the Air Force truly hopes to transform wing-

level aircraft maintenance into a Lean organization, major changes in the current personnel system must be addressed.

A survey on change management published by the American Management Association and Deloitte & Touche had the following conclusion: "It seems that many organizations have to change in order to change. Their *present structures and cultures* tend to disallow the successful implementation of change initiatives" (emphasis added).[123] The Air Force personnel system is one of those "present structures" and must change as it currently exists to support maintenance leadership if the Air Force has any hope for true transformational breakthroughs in its flying wings. The basic personnel system in use today is essentially the same system that was adopted from the Army in 1947, when the Air Force became a separate service. That Army system was originally developed in 1890 by the secretary of war, Elihu Root.[124] The core tenets of our personnel system—top-down evaluations in a hierarchical bureaucracy and frequent moves for career development—are nearly 120 years old![125] So today we have a century-old system that prepares Airmen to function in a vertical, hierarchical bureaucracy that stifles innovation and actually works against the creation of learning organizations.

The first personnel issue that must be addressed is performance evaluation. While the Air Force has tinkered through the years with minor changes, such as required evaluation comments, rating categories, and endorsement levels, the system is essentially unchanged. Performance reports are based purely on an evaluation by an Airman's rater and the rater's rater.[126] The Air Force needs risk-taking, out-of-the-box thinkers to succeed in a Lean AFSO21 transformation, but our actual performance evaluation system supports a hierarchical, risk-averse bureaucracy. In this system, red continues to be bad. A single evaluation report that uses moderate praise rather than enthusiastic endorsement will kill an officer's or senior NCO's career. An innovative, out-of-the-box-thinking officer need have only one risk-averse, control-oriented boss, and his or her career is essentially finished.[127] The Air Force needs to move forward in the 21st century by considering performance evaluation alternatives that support a transformed Lean organization. The answer may be a 360-degree system or some other method of

rewarding risk-takers rather than leaders who are naturally driven to become risk-averse careerists. There are many large organizations using similar successful systems to benchmark. The time is right for Air Force senior leadership to tackle this contradictory, outmoded evaluation system.

The second personnel policy requiring reform is the assignment policy for maintenance officers and senior NCOs. In the current Air Force model, frequent moves and a wide variety of duties are required in the name of career development. The goal is to grow leaders with a wide variety of skills to function at the top of the hierarchical pyramid. This has created a host of officers and senior NCOs who are aircraft maintenance generalists rather than experts. A typical officer's career includes maintenance management on a variety of aircraft, from heavy lift transportation to high-demand, low-density reconnaissance aircraft to small fighters, alternating between staff assignments at the field-grade level. The same happens, though not as frequently, to NCOs once they reach the grade of master sergeant and join the senior NCO corps. While the basic maintenance organization, procedures, and policies are the same for all these kinds of aircraft, the aircraft-specific processes are considerably different. Most maintenance officers and many senior NCOs are, in effect, amateurs by profession. They never get the chance to spend enough time on one aircraft or in one job to become true experts.[128] This is no way to create a learning organization where value-stream leaders are expert level at every process they control.

Again, the Air Force needs to redesign "present structures" in order to change. Aircraft maintenance officers and senior NCOs should be closely tied to the aircraft they maintain. While this is currently done very loosely with special experience identifiers, there is no governing policy that states, for example, once assigned as a career C-5 maintenance officer, an Airman will remain a C-5 maintenance officer. Ideally, a typical active-duty maintenance officer would rotate among C-5 bases in the continental United States as well as overseas enroute locations primarily supporting C-5s. If assigned to a MAJCOM or Air Force staff, his or her focus would be the C-5 if at all possible. Staff tours would be followed by a rotation back to a C-5 field unit. Permanent change-of-station assignments to primarily maintain other aircraft for career

broadening would be the exception rather than the rule. This may sound like a radical change, but in reality it mirrors how personnel are currently managed in the rated community. The Air Force would never consider taking a pilot with three years of experience flying the U-2, send him for one year to fly F-16s in Korea, and then rotate him back to the United States to fly KC-135s in North Dakota. Perversely, this is routine for Air Force maintenance officers and senior NCOs. More often than not, the resulting outcome at wing level is field-grade aircraft operators with vastly superior system knowledge compared to their aircraft maintenance counterparts on the other side of the table. Toyota and other mature Lean firms get brilliant results by giving expertly trained value-stream managers complete responsibility for end-product success.[129] If the Air Force hopes to break through and do the same, it needs leadership at the highest levels to consider bold changes to our outdated personnel system and create learning organizations in wing-level aircraft maintenance.

Summary and Recommendations

By 2012 the average USAF aircraft is projected to be more than 26 years old. Simultaneously, as this indefinite trend continues, support funding and manpower are expected to stagnate. The Air Force has no choice but to mitigate the aging air fleet's impact on readiness by transforming its culture to one where continuous process improvement is the accepted way of doing business. Already there have been noteworthy process-improvement successes at the ALC depots as well as some flying wings. However, the Air Force enterprise has yet to truly transform so that all Airmen actively seek to improve their value-stream processes. In the aircraft maintenance community, service-wide changes must be incorporated to enable a metrics-driven culture change supporting continuous process improvement. These changes include establishing organizational policies and business rules to ensure that new information technology systems do not result in a drift away from the current, highly successful decentralized repair process of aircraft and spare parts. Furthermore, significant changes in the personnel evaluation system, assignment process,

and rotation policy for all officer and NCO maintenance leaders are in order.

The answer to RQ1 is yes—metrics do drive culture and influence behavior. The best metrics are those developed with an eye towards worker involvement that tie value directly to an organization's customer by ensuring end products are delivered on time with the right quantity, quality, and price.[130] The ultimate goal is to create a Red Is Good culture, where problems are viewed as opportunities and the bearer of bad news is lionized rather than ostracized. In this cultural transformation, metrics are not pass/fail indicators but instead measure process efficiency and effectiveness and identify trends.[131]

For the Air Force maintenance community to successfully attain a Red Is Good transformation, as addressed in RQ2, current enterprise-level metric deficiencies must first be addressed. Recent AFLMA and GAO research studies raise questions about the validity of aircraft maintenance data as well as the associated goals set by higher headquarters. Studies also demonstrate how nonaligned metrics suboptimized enterprise-level performance in the Air Force. Finally, in too many organizations constant deficiency identification through metrics remains the exception rather than the norm. Instead, a Green Only mentality permeates wing leadership, who, often due to its own self-preservation instinct, has a low tolerance for items marked red for noncompliance.[132]

Only by becoming a true learning organization can the Air Force maintenance community hope to advance its transformation towards a permanent, Red Is Good, continuous process-improvement culture. The Air Force needs to create an environment that breeds chief process officer leaders as RQ3 proposes. These leaders must be capable of establishing the right process-performance metrics, devising improvements—or if a process is clearly broken, re-engineering it—and establishing a continuous program of process optimization.[133] Air Force–level policies must be changed in order to grow chief process officers and enable a service-wide continuous process-improvement environment. These changes include establishing new business rules to ensure the new ECSS does not evolve towards centralized repair of end-item spare parts. Additionally, the

century-old Air Force personnel management system must be overhauled to support a culture of learning among aircraft maintenance leaders. First, a personnel evaluation system supportive of risk-taking, outside-the-box thinkers needs to be introduced. A method of rewarding these learning leaders with advancement and responsibility should replace the current system, which rewards leaders naturally driven to become risk-averse careerists. Second, the Air Force needs to move away from an assignment process that overwhelmingly results in maintenance leaders becoming airplane generalists. Rather, maintenance officers and senior NCOs should be permanently tied to specific aircraft models in order to become expert-level value-stream leaders.

Significant enterprise-level changes are required by the Air Force for a true process improvement culture to take hold. To continue effective maintenance of the total force in this era of declining resources, there is no choice but to seek out and implement the changes required to enable lasting and significant transformation.

Notes

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129. Womack and Jones, *Lean Thinking*, 321.

130. Hamm, "Thinking and Fighting as an Enterprise: Building the Culture of Air Force Smart Operations for the 21st Century," 20.

131. Pendley et al., "Aligning Maintenance Metrics," 12.

132. Dailey, "On the SECDEF's Argument that the Air Force Lacks a 'Culture of Self-Criticism.'"

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